

sides the blue and violet, saw Angström's green aurora* line perpetually over citron acetylene at W.L. 5579, and the red aurora line between sodium α and lithium α , but nearer to the latter, say at W.L. 6330.

3. Now, W.L. 6350 in the solar spectrum is a pretty bright scarlet red, so that orange could easily be made of it by the green aurora mixing therewith, and the spectroscope separates each of the two kinds of light with perfect ease. But how came potassium red or W.L. 7700, *i.e.*, the blood red, lurid red, and tragedy red of painters to appear so markedly to the naked eye, and yet not be seen at all in the spectroscope, either as a new ingredient or an altered place of the red line? It would apparently be by the mixing up of rays and streamers of the blackness out of that long, low dark arch on the northern horizon. But when a spectroscope fails (as fail it must) to show a characteristic line for a region of blackness, what other instrument can we take to prove the case?

Excessively faint greenish and bluish lines appeared at wave lengths 5300, 5100 and 4900 nearly; but the main light in the spectroscope was to the extent of 8-tenths of the whole, that of the green line 5579, and of 17-tenths the red line 6350; while to the naked eye the splendour of the display and its variety consisted in triple mixtures of 5579, 6350, and the unknown dark medium. Could something be ascertained about that, if those who have good telescopic star spectroscopes were to observe a star when shining through one of these inky black arches?

At 9.30 P.M. when all the aurora had faded or passed away towards the south, where a few straggling pink patches still appeared, the northern horizon and its sky being now free from the black arch, as well as the green streamers, perfectly astonished me by the clear pellucid blue of a true starlight night sky in a bright climate and clear atmosphere. Evidently the dark arch and streamers are as much a part of the aurora as the green and red lights, but how to investigate them—that is the question.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, Feb. 5

LAST evening an aurora of rather unusual brilliancy was seen here. I happened to be out with a friend in the country about sunset, when the sky was completely overcast and fine rain was falling. We noticed that darkness did not come on so quick as usual, and at 7 o'clock it was so light as to lead my friend to believe that the moon was shining above the clouds. Later in the evening slight breaks began to appear in the clouds, through which the first magnitude stars were just visible, and through these openings an intense red illumination appeared. The spectroscope gave from every part of the heavens a very bright line in the green, and another fainter one nearer the blue, together with a diffused light over the green and blue parts of the spectrum. The brightest part of the aurora was towards the S.W. From the large amount of light, although it was raining at the time, it must have been one of the brightest auroras that have been witnessed for years.

G. M. SEABROKE

Rugby, Feb. 5

COMING up the Channel on Sunday night last in the P. and O. screw-steamer *Delta*, about 9.40 P.M., I saw a very fine aurora. The sky was cloudy, which somewhat dimmed its brightness, but it was rather brilliant towards the N.

Having a Hoffman's direct vision spectroscope with me, I turned it towards the brightest red portion which lay towards the N.E., and with a moderate slit got a very sharp and distinct line in the green at or near the position of F in the solar spectrum. No other lines were visible. But on removing the telescope, and observing the spectrum with the naked eye, a fine crimson line revealed itself near C; the colour of it was exactly that of hydrogen α , as seen in a vacuum tube.

I also thought that there were faint traces of structure visible in the blue and violet, but of this I cannot be sure.

There had been traces of auroral phenomena visible early in the same evening. The green line was so distinct that unpractised observers saw it easily. The red line, however, was much fainter, and appeared to flicker.

I much regret that I had no means of recording the position of the lines.

R. J. FRISWELL

ABOUT six o'clock on Sunday evening the ruddy appearance of the upper clouds gave warning of an aurora in prospect, but I was not prepared for the magnificent sight which appeared on

looking out an hour later. The higher part of the sky seemed covered with bright rose-coloured clouds, which, from the dark masses of clouds passing underneath, seemed continually to be shifting in position. Intervals of deep green appeared amongst the red, and these, when looked at with a spectroscope, gave a stronger light than their surroundings. Objects near were illuminated as if the moon had risen behind the clouds. I had a miniature spectroscope of Browning's, with which I examined the brightest parts, and obtained four lines—one very bright green, two very faint nebulous green bands, and one red line. Having a spirit lamp handy, in which were remnants of sodium, lithium, and sulphate of copper, I was able roughly to estimate the positions of the lines. The red was about a third from *D* towards the lithium line; the very bright green about a third from *D* to the copper line near *b*, the other faint green bands were more refrangible, and I should think their places were between *b* and *F*, and near *F*, but I could not get their positions so well as the other two; certainly the most refrangible was not so far as the violet-potassium line which I could see in the field.

The light green was present everywhere, the red only showed occasionally with very varying intensity, and the most refrangible green line was also continually varying, but it was brighter than the second green line.

The light around attained its maximum about a quarter to eight, and then very slowly diminished to about midnight, when it had nearly disappeared. A light drizzling rain was falling the whole time.

J. P. MACLEAR

Shanklin, Feb. 5

THERE has been a magnificent red aurora here this evening. I saw it first before twilight had quite disappeared, and at first thought it was the crimson of sunset unusually late. It was at its finest between six and seven; at that time there were columns of light shooting up from the horizon almost to the zenith, and occupying almost half the horizon from the E. of N. round by E. The crimson colour was variegated with bluish white in a way that I have not seen before. The barometer was at about 29.45 inches, with a strong breeze from the south.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, Feb. 4

THERE was a fine display of aurora here yesterday evening. I first observed it about 5.30, just in the twilight, but it was then confused with the rays of the setting sun; as the darkness deepened the aurora came out alone, and was then extremely beautiful. It extended from the extreme N.E. to the extreme N.W., but from the reflection of the numerous clouds, appeared to have a much larger area. It was of a bright crimson colour, with the rays golden or orange, of which, however, only a very few were visible.

As the evening came on, about 8 o'clock, the clouds gradually became thicker, and at last almost entirely covered the sky; the only effect then apparent was a deep red glow, which continued with unequal intensity until 11.45, and with all probability much later. At 9.35 there was a break in the clouds towards the E., when the aurora shone forth in all its splendour. The aurora was most certainly visible in daylight, just appearing as the twilight came on.

I have no doubt if the atmosphere had been clearer, we should have had a most magnificent display; as it was, the effect was really beautiful.

J. S. H.

Gloucester, Feb. 5

THERE has been a magnificent and extensive auroral display this evening, of which I beg to send you the following account.

After a very heavy fall of rain, which lasted in this part of the country from 1 o'clock P.M. until 5.30 o'clock, there were collected in the northern horizon numerous *cirro-stratus* clouds, which gradually at first, and afterwards rapidly, moved towards the E., with the strata to the S. As these were passing away, I saw, about midway between these clouds and the zenith a bright patch of pale red light, which became well defined by 6 o'clock. A few minutes after this appeared I saw in the N.W. another patch of red light, and by 6.15 there stretched from N., N.W., and N.E. three very broad streamers converging in the zenith, and forming a splendid crimson canopy, the streamers being quite separated, until meeting, by dark spaces. These slowly disappeared, and of a sudden there appeared a bluish-white streamer stretching N.E. to and passing the zenith by about 10°.

At this time I could see that the Pleiades were partly covered, although not hidden, by a part of this streamer. At 6.35 it faded away. At 6.40 light clouds began to rise in the W. and S.W., and as I recognised this phenomenon as auroral, having seen similar clouds on other occasions of auroral displays, I carefully watched them, and saw at 6.50, in the S.W., a crimson-coloured patch, undefined in shape, originating from the light clouds. At 6.55 there shot up from the S. beautiful red, crimson, and blue streamers, which converged in the zenith. At 6.58 other bands of crimson and blue arose due S., and joined the others in the zenith. At 7.0 I was quite astonished to see the aurora appear in the S.S.E., by which time the previous brilliant display in the S. had dimmed, and the whole of them formed a southern canopy. During this southern display, the northern parts were quite dark, with heavy looking clouds; but at 7.5 the clouds slightly broke up, and I saw a faint redness in the N.E., about 45° above the horizon. By this time the southern streamers and patches began to spread and assume a mottled appearance, which reached by 7.10 the N.W. At 7.15 the N.W. and E. were quite dark and cloudy, and there remained only slight traces of the aurora in the S.W. high up in the heavens, and by 8.35 it had entirely disappeared.

JOHN JEREMIAH

Park, Tottenham, Feb. 4

DOUBTLESS many of your readers witnessed the magnificent aurora which occurred on Sunday, February 4. If any one else has noted the position of the radiant point, as seen from this station, the following observations, made somewhat roughly, from this place (lat. $53^\circ 17' 8''$ N., long. $6^\circ 10' 22''$ W., nearly) may be of use in determining approximately the height of that point above the earth.

At 7.15 (Greenwich time) its zenith distance was 23° ; its bearing in azimuth 4° E. of S. At 7.30 its zenith distance was the same; its azimuth 15° E. of S. At 9.10 its zenith distance was 13° ; its azimuth 1° W. of S.

M. H. CLOSE

Newton Park, Blackrock, Dublin, Feb. 5

LAST evening (Sunday, Feb. 4) there was a brilliant display of aurora visible in North Devon with some unusual features. At 6 o'clock the sky was clear, except a cloud of deep rose aurora over Orion, and another detached portion toward the west. This soon developed into a cloudy arch of the same colour stretching from east to west; then, a little south of the zenith between the Pleiades and Aldebaran, this arch culminated to an obtuse point of white cloud, something like a broad gothic arch. The northern half of the heavens was quite clear, but a series of radiations towards the south, and spreading east and west, issued from this point. For some time it seemed doubtful whether it was aurora, or a peculiar appearance of the clouds caused by high air currents, and a refraction of light from the sun's rays in the higher regions of the atmosphere. At one time there was some appearance of spiral radiations, or drift of cloud from this point near the zenith, with a distinct but irregular gap of clear sky, somewhat similar to the Coalhole in the galaxy near the Southern Cross; but this did not last long, although the general appearance was continued for more than half an hour, with varying play of light, over a space of about 140° of the southern heavens, with pretty well-defined eastern and western boundaries of deep rose colour, culminating in the white focus near the Pleiades, which appeared the centre of action. The rose colour was chiefly confined to the eastern and western boundaries, with intermitting starts of whitish radiation toward the south. Occasionally well-defined streaks of a lighter tint crossed the western portion of the rosy cloud, which appeared to originate from the light of the sun, now, of course, far below the horizon. At length the eastern portion became less brilliant, but still Orion was enveloped in a steady rosy haze, although it gradually became fainter, until, a little before 7 o'clock, the rosy colour below Orion toward the eastern horizon became as brilliant as ever, and soon a straight broad ray of rose colour started up from the horizon. This was not curved or arched, like the whiter radiations which seemed to originate from near the zenith; nor was it, like them, intermittent and wavy; but had the appearance of a broad beam of rosy light originating below the horizon, and darting straight upward in a diagonal direction, proceeding over Castor and Pollux and Jupiter. Then the north side of this became of a peculiar light bluish green; if I may be allowed to coin a word, it was of a moonshiny colour. If the moon had been a few days younger, I should have thought it originated from the

moon. This very peculiar and distinct broad beam or bar of light almost developed prismatic colours from its southern rosy edge; to its northern bluish-green well defined border. There was also a somewhat indistinct tendency to the same prismatic appearance, spreading some little distance over the heavens on the south side of this beam near the zenith. The northern segment of the sky from Castor and Pollux to about direct west was still perfectly clear, both from cloud and aurora, right down to the horizon; there was a bank of cloud along the southern horizon. About 7 o'clock there was an appearance of rosy tint to the north of the peculiar straight bank spoken of, and this reached as far as the pointers in the Great Bear. About the same time there was a peculiar development of white cloud from the zenith toward the north-west, streaked and fringed with well defined radiations, and this gradually increased until the northern portion of the heavens, which had hitherto been quite clear, was covered to within 30° of the horizon, the border of this cloud being very distinctly and deeply serrated with fan-like shapes radiating from near the zenith. The phenomena I have described occupied more than an hour, and my attention was now drawn from it until after 8 o'clock, when the whole heavens were cloudy, but behind and between the clouds the rosy tint was still visible as an irregular arch stretching from north to west. As the clouds broke off the whitish wavy radiation could be occasionally seen still issuing from near the zenith, and across the western part of the rosy arch were occasionally seen the straight diagonal bars of a brighter shade, apparently caused by the light of the sun, but the clouds obscured most of the phenomena. At a last look near 9 o'clock the clouds had somewhat cleared, and there were two brilliant arches, more like the regular aurora from the north-west horizon towards the zenith, at right angles to the more cloudy arch, which had been visible for some time stretching from the north to the west.

W. SYMONS

Barnstaple, Feb. 5

LAST evening (Sunday, February 4) the sky presented a weird and unusual aspect which at once struck the eye. A lurid tinge upon the clouds which hung around suggested the reflection of a distant fire, while scattered among these torn and broken masses of vapour having a white and phosphorescent appearance, and quickly altering and changing their forms, reminded me of a similar appearance preceding the great aurora of October 1870. Shortly some of these shining white clouds or vapours partly arranged themselves in columns from east to west, and at the same time appeared the characteristic patches of rose-coloured light which are seen in an auroral display.

About 8 o'clock the clouds had to a certain extent broken away, and the aurora shone out from behind heavy banks of clouds which rested on the western horizon, the north-eastern horizon being free from cloud and shining brightly with red light. And now, at about 8.15, was presented a most beautiful phenomenon. While looking upwards I saw a stellar-shaped mass of white light form in the clear blue sky immediately above my head, not by small clouds collecting, but apparently forming itself in the same way as a cloud forms by condensation in a clear sky on a mountain top, or a crystal shoots out in a transparent liquid, leaving, as I fancied, an almost traceable nucleus or centre with spear-like rays projecting from it; and from this in a few seconds shot forth diverging streamers of golden light, which descending met and mingled with the rosy patches of the aurora hanging about the horizon. The spaces of sky between the streamers were of a deep purple (the effect of contrast), and the display, though lasting a few minutes only, was equal if not excelling in beauty, though not in brilliancy, the grand display in 1870, before alluded to, in which latter case, however, the converging rays met in a ring or disc of white light of considerable size.

What struck me particularly was the aurora developing itself as from a centre in the clear sky, and the diverging streamers apparently shooting downwards, whereas in the ordinary way the streamers are seen to shoot up from the horizon and converge overhead. The effect may have been an illusion, but if so it was a very remarkable one. Examined with one of Mr. Browning's direct seven-prism spectroscopes, I saw the principal bright line in the green everywhere (the other lines were not visible), and noticed the peculiar flickering in that line which I noticed in 1870, and which has also I think been remarked by Sir John Herschel. The general aurora lasted for some time till lost in a clouded sky, and in fact rain was descending at one time while the aurora was quite bright. Strong wind prevailed during the